

**WHAT IS CLAIMED IS:**

1. An apparatus for heat treating semiconductor wafers comprising:

a thermal processing chamber adapted to contain a semiconductor wafer; and

5 a heating device in communication with said thermal processing chamber for heating a semiconductor wafer contained in said chamber, said heating device comprising:

10 (a) a plurality of light energy sources configured to emit light energy onto said semiconductor wafer, said light energy sources comprising linear lamps horizontally oriented with respect to said wafer, said light energy sources being positioned so as to form an irradiance  
15 distribution across a surface of said wafer; and

(b) at least one tuning device positioned amongst said light energy sources, said tuning device being configured to change the irradiance distribution of said light energy  
20 sources in a manner for more uniformly heating said semiconductor wafer.

2. An apparatus as defined in claim 1, wherein said tuning device comprises an arc lamp.

3. An apparatus as defined in claim 1, wherein said tuning device comprises a laser.

4. An apparatus as defined in claim 1, wherein said tuning device further comprises at least one focusing lens, said focusing lens being configured to focus light energy being emitted by  
5 said tuning device.

5. An apparatus as defined in claim 1, further comprising a light pipe positioned in operative association with said tuning device for directing light energy being emitted by said tuning

5 device onto said semiconductor wafer.

6. An apparatus as defined in claim 1, wherein said tuning device is positioned to heat the outer edges of said wafer.

7. An apparatus as defined in claim 1, further comprising:

at least one temperature sensing device for sensing the temperature of said semiconductor wafer at least at one location; and

a controller in communication with said at least one temperature sensing device and at least certain of said light energy sources, said controller being configured to control the amount of light energy being emitted by said light energy sources in response to temperature information received from said at least one temperature sensing device.

8. An apparatus as defined in claim 1, further comprising a substrate holder for holding said semiconductor wafer, said substrate holder being configured to rotate said wafer.

9. An apparatus as defined in claim 3, wherein said laser emits p-polarized light.

10. An apparatus as defined in claim 9, wherein said laser emits light energy having an angle of incidence relative to said semiconductor wafer of about 40° to about 85°.

11. An apparatus as defined in claim 1, wherein said tuning device comprises a plurality of lasers, said lasers emitting light energy at more than one wavelength.

12. An apparatus for heat treating semiconductor wafers comprising:

a thermal processing chamber adapted to contain a semiconductor wafer;

5           a substrate holder positioned within said thermal processing chamber, said substrate holder being configured to hold said semiconductor wafer and rotate said wafer in said chamber; and

10           a heating device in communication with said thermal processing chamber for heating a semiconductor wafer contained in said chamber, said heating device comprising:

15           (a) a plurality of linear lamps configured to emit light energy onto said semiconductor wafer, said linear lamps being horizontally oriented with respect to said wafer and extending from one side of said thermal processing chamber to an opposite side, said linear lamps being positioned so as to form an irradiance distribution across the surface of said wafer; and

20           (b) a plurality of tuning devices, said tuning devices being configured to emit focused light energy onto particular locations of said wafer thereby changing the irradiance distribution of the linear lamps in a manner for more uniformly heating said semiconductor wafer, at least certain of said tuning devices being positioned to heat the outer most edges of said semiconductor wafer.

13. An apparatus as defined in claim 12, further comprising:

5           at least one temperature sensing device for sensing the temperature of said semiconductor wafer at least at one location; and

10           a controller in communication with said temperature sensing device, with at least certain of said linear lamps, and with said tuning devices, said controller being configured to control the amount of light energy being emitted by said linear lamps and said tuning devices in response to

temperature information received from said temperature sensing device.

14. An apparatus as defined in claim 13, wherein said controller is configured to control the amount of light energy being emitted by said tuning devices independently of said linear lamps.

5 15. An apparatus as define in claim 12, wherein said tuning devices comprise lasers.

16. An apparatus as defined in claim 12, wherein said tuning devices comprise arc lamps.

10 17. An apparatus as defined in claim 15, wherein said lasers emit p-polarized light.

18. An apparatus as defined in claim 15, wherein said lasers emit light onto said wafer at an angle of incidence of from about 40° to about 85°.

15 19. An apparatus as defined in claim 12, wherein said tuning sources comprise lasers, said lasers emitting light energy at more than one wavelength.

20 20. An apparatus for heat treating semiconductor wafers comprising:

a thermal processing chamber adapted to contain a semiconductor wafer;

25 a substrate holder positioned within said thermal processing chamber, said substrate holder being configured to hold said semiconductor wafer and rotate said wafer in said chamber; and

30 a heating device in communication with said thermal processing chamber for heating a semiconductor wafer contained in said chamber, said heating device comprising:

(a) a plurality of linear lamps configured to emit light energy onto said semiconductor wafer, said linear lamps being

horizontally oriented with respect to said wafer  
and extending from one side of said thermal  
processing chamber to an opposite side, said linear  
lamps being positioned so as to form an irradiance  
distribution across the surface of said wafer; and

a plurality of tuning devices that emit  
focused light energy onto certain locations on said  
wafer, said tuning devices being configured to  
change the irradiance distribution of said linear  
lamps in a manner for more uniformly heating said  
semiconductor wafer, wherein said tuning devices  
comprise a light source selected from the group  
consisting of arc lamps, lasers or mixtures  
thereof.